Remarks/Arguments:

Claims 1-14 are pending in this application. Claims 1-5 and 7-14 are rejected under 35U.S.C.103(a) as being unpatentable over Kato (U.S. Patent No. 6,462,738) in view of Migdal et al. (U.S. Patent No. 6,356,263). Applicant has amended Claims 1, 8, 13, and 14, canceled Claims 6 and 12, and added a new Claim 15. No new matter has been added.

Structure of the pending claims

The pending claims are structured as follows: Claims 1 – 7 recite a method for approximating CAD data representing a three-dimensional object; Claims 8 – 12 recite a method for displaying a three-dimensional object represented by CAD data; Claim 13 recites a program product for approximating CAD data representing a three-dimensional object; and Claim 14 recites a program product for displaying a three-dimensional object represented by CAD data. Claims 1 and 13 are independent claims geared toward the approximation; and Claims 8 and 14 are independent claims geared toward the display. Claims 2 – 7 depend from Claim l; and Claims 9 – 12 depend from Claim 8.

Allowable subject matter

Claim 6 is objected to as being dependent upon a rejected base claim, but the Examiner states that it would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicant has amended Claim 1 to include the allowable subject matter recited originally in Claim 6 and canceled Claim 6. Thus, Claim 1 and its dependent Claims 2 -5 and 7 are now in a condition for allowance. Claims 2 - 5 and 7 are hereby resubmitted.

Claim 13 is a program product claim corresponding to Claim 1, which is a method claim, both geared toward the approximation. Similar to the amendment made to Claim 1, Claim 13 has been amended to incorporate the allowable subject matter recited originally in Claim 6. Thus, Claim 13 is now in a condition for allowance.

With the above amendments, Claims 1 and 13 describing the approximation now include the passage "generating the control points between two internal points by use of the

normal vector at each of the internal points, generating the control points between one internal point and one boundary point by use of the normal vector at each of the internal and boundary points, and generating the control points between two boundary points by use of the tangential vector at each of the boundary points," which the Examiner acknowledged as an allowable subject matter.

In addition, Applicant has added a new Claim 15, which is dependent from Claim 13. The new Claim 15 is a program product claim reciting the subject matter corresponding to Claim 2: "joining adjacent two polygons from different faces across the boundary edge by identifying the boundary points common to both of the polygons," which is one of the important features associated with the present invention. Since Claim 13 is now in allowable form, Claim 15 that depends from Claim 13 should be allowable as well.

Thus, Applicant respectfully submits that the rejections under 35U.S.C.103(a) of Claim 1, its dependent Claims 2 – 5 and 7, as well as Claim 13 are hereby rendered moot by these amendments, and the new Claim 15 is in allowable form.

<u>"Approximation" claims vs. "Display" claims</u>

The Examiner rejects Claims 8 – 11 and 14 based on the rationales same as those for rejections of Claims 1, 3 – 5, and 7. (See line 4 - 8 on page 6 and line 3 – 6 on page 7 in the Office Action.) However, Applicant respectfully submits that these two sets of claims pertain to completely different subject matters, and thus these rationales for the rejections of Claims 8 – 11 and 14 are ungrounded. It should be emphasized here again that, in contrast to Claims 1 - 7 and 13 that are geared toward the <u>approximation</u>, Claims 8 - 11 and 14 are geared toward the <u>display</u>.

Specifically, the mesh regeneration in the step (f) in Claim 1 is for approximating each face of a three-dimensional object with triangular or quadrilateral surfaces within a specified tolerance, whereas the tessellation in the step (k) in Claim 8 is for displaying the above approximated face according to acquired display conditions.

It appears that the Examiner mistakenly interpreted the <u>tessellation procedure for the display</u> to be the same as or related to the <u>mesh regeneration procedure for the approximation</u>. For example, the Examiner states that "with respect to Claim 7, Kato discloses the method of Claim 1, further comprising generating a control mesh from the surface representation using

known tessellation techniques to extract polygon data from the surface representation (column 3, lines 44 – 47)." However, Claim 7 in the present application has no relation to "generating a control mesh .... using known tessellation techniques ." Rather, the tessellation in the present invention is performed on the approximated face for the purpose of display as shown, for example, in FIG.5(c).

In order to clarify the above difference, the following amendments have been made herein.

First, the preambles of Claims 1 and 13 have been amended to include the passage "by approximating each face of the three-dimensional object with triangular or quadrilateral surfaces within a specified tolerance" to emphasize that that these claims are geared toward the approximation.

Second, the preamble of Claim 8 has been amended to clarify that the polygons to be displayed (if the detailed display is not needed) are obtained by the approximation method described in Claim 1. Claim 8 has been further amended to include the step of display switching originally recited in Claim 12 to clarify the display procedure in the method. Namely, the polygons are displayed if the detailed display is not needed; or tessellation of the face approximated with the triangular or quadrilateral surfaces is carried out to produce sub-polygons to be displayed if the detailed display is needed. Claim 12 has been canceled. Claims 9 – 11 are dependent from Claim 8; thus, they are resubmitted.

Similar to the amendments made to Claim 8, the preamble of Claim 14 has been amended to clarify that the polygons to be displayed (if the detailed display is not needed) are obtained by the approximation method described in Claim 1; and Claim 8 has been further amended to include the command for display switching corresponding to the original Claim 12 to clarify the display flow in the program. Namely, the polygons are displayed if the detailed display is not needed; or tessellation of the face approximated with the triangular or quadrilateral surfaces is carried out to produce sub-polygons to be displayed if the detailed display is needed.

With the amendments above, Applicant would like to explain characteristic features associated with the present invention as below for further clarification.

First, the definitions of geometrical terms are here in order. "Polygons with three or four vertices" in Claim 1 refer to triangles or quadrilaterals, which are flat surfaces. On the other hand,

after "converting each of the polygons with three or four vertices to a triangular or quadrilateral surface by using a plurality of control points" as in step (e) of Claim 1, the present method yields surfaces, which are three-dimensional curved surfaces. Tessellation in Claim 8 is carried out for the display purpose by dividing the surface into sub-polygons, which are flat surfaces.

In short, as the preamble of the amended Claim 1 states, Claim 1 discloses a method for approximating each face of a three-dimensional object represented by the CAD data with triangular or quadrilateral surfaces within a specified tolerance, and the key points pertaining to this approximation method are summarized as follows:

- First, each face of the three-dimensional object represented by the CAD data is divided by mesh lines for approximating it with polygons within a rough conversion tolerance, which is not as tight as the specified conversion tolerance.
- Next, the polygons are converted to surfaces by using information on vertices, normal vectors, and tangential vectors if the points are at a boundary edge.
- Thereafter, it is examined if each of the surfaces is close to the original CAD data within the specified tolerance, and if not, the face is divided by more mesh lines for refinement.
- Then, two adjacent polygons from different faces across a boundary edge are joined by identifying the boundary points common to both of the polygons.

The prominent effects that can be obtained by use of the above approximation method include:

- When display conditions are such that detailed display is not needed, the polygons that have been obtained within the rough conversion tolerance can be displayed as they are, thereby leading to faster processing speed and less memory usage.
- In some cases, gaps may be generated at the boundary between two different faces. The present invention proceeds to identify the boundary points, and hence the associated tangential vectors, common to those polygons, so as to avoid the gap generation for smooth and natural appearance.

Applicant believes that the above amendments and explanation elucidate the difference between the mesh regeneration procedure for the approximation and the tessellation procedure

for the display, and at the same time, the unique features and effects associated with the present invention, thereby overcoming the rejections under 35U.S.C.103(a) of Claims 8 – 11, and 14.

Conclusion

Applicant submits that all the claims are now in a condition for allowance and respectfully requests the reconsideration and withdrawal of all the rejections.

In the event that the Examiner wishes to discuss any aspect of this response, please contact the agent at the telephone number identified below.

Respectfully submitted,

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By: Konomi Takeshita

Konomi Takeshita
Registration No. 38,333
Omori & Yaguchi USA, LLC
Agent for Applicant
Eight Penn Center, Suite 1901
1628 John F. Kennedy Blvd.
Philadelphia, PA 19103
Phone No. (215) 701-6349